Model selection using information criterion methods

Dóra Porubszki, László Kamocsai

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1 Introduction

Our research assess the accuracy of model selection using the two well known information criterion, the Akaike (AIC) and the Bayesian information criterion (BIC). In practice the mentioned criterion are widely used to approximate the original data generation process parameters that is, the order of the model, which has an impact for the forecast accuracy. The main differences between the two measures is the way in the terms of penalty when the model order number is increased.

The AIC is an approximately unbiased estimator of the Kullback-Leibler information (Akaike, 1973), but Hurvich and Tsai (1989) have pointed out in their research that the AIC is biased estimate of the KL information, which causes overfitting in the cases of autoregressive time series. The BIC is as a solution for the Bayes model identification problem which has introduced by Schwarz (1978), it is minimized at the model order having the highest posterior probability.

Tsay, Hannan, Hurvich and more analyzed the various criterion measures (AIC, AICc, BIC) and presented simulation results in which have been applied for nonstationary autoregressions and mixed autoregressive moving averages time series models. They result still not give a clear answer the question which information criterion should have been used to determine the proper model orders. Further complicates the problem, Koehler et al. (1988) in their paper presented that the lowest AIC and the lowest BIC often choose different order of ARMA model, and more important result was that as the time series length increased these differences also risen. So it looks the AIC usually overfit the data, so it means BIC is a better criterion, which is corroborated the simulation results of Sneek (1984).

Originally the plan was that we run the simulation on wide range of time series length and noise level, exactly 10, 100, 1000, 10000, but due to the lack of performance, we have chosen 10, 50, 100, 200. The result suggest that when the original model order not so high, both criterion perform well that is, very often find the right model order. As the model order increased the less accurately find the original model complexity. For further research prospect, the plan is to optimize more the code to run it longer time series to get proper result.

2 Simulation results

3 different models are fitted, the orders of the model are the following:

- m1: AR(1), MA(1)
- m2: AR(2), MA(2)
- m3: AR(4), MA(4)

Table 1: Best model by AIC and BIC criteria

	AIC				BIC			
	σ=0.01	σ=0.1	σ=1	σ=2	σ=0.01	σ=0.1	σ=1	σ=2
N=10	m1	m2	m2	m2	m1	m2	m2	m2
N=50	m1	m2	m2	m2	m1	m2	m2	m2
N=100	m1	m2	m2	m2	m1	m2	m2	m2
N=200	m1	m2	m2	m2	m1	m2	m2	m2

The table represents which model was the best more in the relation of the sample size and the noise. The original data generatin process was an ARMA model with order p=2, q=2.

3 different models are fitted, the orders of the model are the following:

- m1: AR(1), MA(1)
- m2: AR(2), MA(3)
- m3: AR(3), MA(4)

Table 2: Best model by AIC and BIC criteria

	AIC				BIC			
	σ=0.01	σ=0.1	σ=1	σ=2	σ=0.01	σ=0.1	σ=1	σ=2
N=10	m1	m2	m2	m2	m1	m1	m2	m2
N=50	m1	m2	m2	m2	m1	m1	m2	m2
N=100	m1	m2	m2	m2	m1	m1	m2	m2
N=200	m1	m2	m2	m2	m1	m2	m2	m2

The table represents which model was the best more in the relation of the sample size and the noise. The original data generatin process was an ARMA model with order p=2, q=3.

3 different models are fitted, the orders of the model are the following:

- m1: AR(1), MA(1)
- m2: AR(3), MA(3)
- m3: AR(4), MA(4)

Table 3: Best model by AIC and BIC criteria

	AIC				BIC			
	σ=0.01	σ=0.1	σ=1	σ=2	σ=0.01	σ=0.1	σ=1	σ=2
N=10	m1	m2	m2	m2	m1	m1	m1	m1
N=50	m1	m1	m2	m2	m1	m1	m1	m1
N=100	m1	m2	m2	m2	m1	m1	m1	m1
N=200	m1	m2	m2	m2	m1	m1	m1	m1

The table represents which model was the best more in the relation of the sample size and the noise. The original data generatin process was an ARMA model with order p=3, q=3.

References

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